BIOTECHNOLOGY AND BIOCHEMICAL ENGINEERING MINOR

This minor provides specific training for McCormick students interested in industries that create and manufacture bio-based fuels and industrial chemicals, pharmaceuticals, biomaterials, and agents for gene and cell therapies or for those desiring in-depth preparation for future graduate study in biotechnology research.

Course	Title
Requirements (10 units)	
6 courses in biological science and biochemical engineering:	
BIOL_SCI 201-0	Molecular Biology [1, 2]
BIOL_SCI 202-0	Cell Biology [1, 2]
BIOL_SCI 203-0	Genetics and Evolution [2]
BIOL_SCI 301-0	Principles of Biochemistry
CHEM_ENG 375-0	Biochemical Engineering
CHEM_ENG 377-0	Bioseparations
Laboratory experience:	
The complete series of 0.34-unit laboratories or one unit of 399 independent study in an approved laboratory [3]	
BIOL_SCI 232-0 & BIOL_SCI 233-0 & BIOL_SCI 234-0	Molecular and Cellular Processes Laboratory and Genetics and Molecular Processes Laboratory and Investigative Laboratory
3 electives providing opportunity for greater depth in both fundamental biology and engineering applications:	
1 course from Core Electives (p. 1)	
2 courses from Extended Electives (p. 1)	

1 CHEM_ENG 275-0 Molecular & Cell Biology for Engineers may substitute for either one

2 The Biotech Minor requires 3 units of Biology coursework. Exemptions or course reductions are NOT granted for students taking the Biological Sciences Department placement test, and who test out of and skip BIOL_SCI 201-0 Molecular Biology. These students may complete BIOL_SCI 202-0 Cell Biology and BIOL_SCI 203-0 Genetics and Evolution and petition to use an upper level Biology course to complete the required 3 units of Biology coursework.

3 Biological Science laboratories are now connected to the intro sequence courses, and registration in the lab is required. Students who are transferring credit from a previous institution where there is no coupled lab, or who do not have one full unit of laboratory credit, may use a previously approved independent study. Any student may choose to substitute a previously approved independent study unit in place of the three laboratory courses.

- A minimum GPA of 2.0 is required in courses in the minor.
- A BA or BS degree from Northwestern must be completed.
- No more than 6 units may be double-counted to fulfill requirements in the major program for catalog years 2022 to present. For catalog years 2021 and earlier, no more than 5 units may be double-counted to fulfill requirements in the major program.
- A maximum of 2 units not offered by the department may be taken P/N for the minor. Students must also comply with departmental and McCormick P/N regulations for courses that are double-counted toward requirements in the minor and major programs.
- Students not majoring in chemical engineering should take the Biological Sciences intro sequence BIOL_SCI 201-0 Molecular Biology, BIOL_SCI 202-0 Cell Biology, BIOL_SCI 203-0 Genetics and Evolution, and BIOL_SCI 301-0 Principles of Biochemistry before CHEM_ENG 375-0 Biochemical Engineering and CHEM_ENG 377-0 Bioseparations. They should also take CHEM 342-1 Thermodynamics and the recommended BIOL_SCI 315-0 Advanced Cell Biology to prepare for CHEM_ENG 375-0 Biochemical Engineering and CHEM_ENG 377-0 Bioseparations.
- Students must submit an up to date minor declaration form in MAS (McCormick Advising System) (https://mas.mccormick.northwestern.edu/) before the beginning of their final quarter as undergraduates. Petitions for counting the independent study units are also completed in MAS.

Minor Electives

Core Electives

Course	Title
CHEM_ENG 372-0	Bionanotechnology
CHEM_ENG 373-0	Biotechnology and Global Health
CHEM_ENG 376-0	Principles of Synthetic Biology
CHEM_ENG 378-0	Deconstructing Synthetic Biology – Biotechnology Case Studies Across Scales
CHEM_ENG 379-0	Computational Biology: Analysis and Design of Living Systems
CHEM_ENG 382-0	Regulatory Sciences in Biotechnology
CHEM_ENG 470-0	Molecular Folding and Function
CHEM_ENG 478-0	Advances in Biotechnology
CHEM_ENG 395-0	Special Topics in Chemical Engineering (must be approved by petition)

Extended Electives

Course	Title
CHEM_ENG 372-0	Bionanotechnology
CHEM_ENG 373-0	Biotechnology and Global Health
CHEM_ENG 376-0	Principles of Synthetic Biology
CHEM_ENG 378-0	Deconstructing Synthetic Biology – Biotechnology Case Studies Across Scales
CHEM_ENG 379-0	Computational Biology: Analysis and Design of Living Systems
CHEM_ENG 382-0	Regulatory Sciences in Biotechnology
CHEM_ENG 470-0	Molecular Folding and Function
CHEM_ENG 478-0	Advances in Biotechnology
CHEM_ENG 395-0	Special Topics in Chemical Engineering (must be approved by petition)
BIOL_SCI 315-0	Advanced Cell Biology
BIOL_SCI 323-0	Bioinformatics: Sequence and Structure Analysis
BIOL_SCI 328-0	Microbiology
BIOL_SCI 332-0	Conservation Genetics
BIOL_SCI 341-0	Population Genetics
BIOL_SCI 355-0	Immunobiology
BIOL_SCI 361-0	Protein Structure and Function
BIOL_SCI 363-0	Biophysics
BIOL_SCI 378-0	Functional Genomics
BIOL_SCI 380-0	Biology of Cancer
BIOL_SCI 390-0	Molecular Biology of Genome Editing and Engineering

BIOL_SCI 395-0	Molecular Genetics
BMD_ENG 304-0	Quantitative Systems Physiology (Formerly BMD_ENG 302)
BMD_ENG 317-0	Biochemical Sensors
BMD_ENG 340-0	Pharmaceutical Engineering: From Discovery to Therapeutics
BMD_ENG 343-0	Biomaterials and Medical Devices
BMD_ENG 344-0	Biological Performance of Materials
BMD_ENG 346-0	Tissue Engineering
BMD_ENG 347-0	Foundations of Regenerative Engineering
BMD_ENG 348-0	Applications of Regenerative Engineering
BMD_ENG 443-0	Biological Phenomena in Cell/Cell-Free Systems
BMD_ENG 446-0	Biomaterials in Synthetic Biology
CHEM 215-3	Organic Chemistry III (Formerly CHEM 210-3)
CIV_ENV 361-1	Environmental Microbiology
CIV_ENV 442-0	Environmental Biotechnology for Resource Recovery
MAT_SCI 353-0	Bioelectronics
Independent Study 399 in approved laboratory	